CLAIMS:

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1. A motion picture decoding apparatus comprising:

a coefficient reducing circuit for removing orthogonal transform coefficients for high horizontal frequencies from a certain sized block of orthogonal transform coefficients obtained from an input signal, thereby reducing the number of transform coefficients to half;

an inverse orthogonal transformation circuit for performing an inverse orthogonal transform operation by using the transform coefficients reduced by the coefficient reducing circuit, thereby obtaining, on a block-by-block basis, reconstructed image data or time-axis prediction error data horizontally compressed to 1/2;

an adder for generating reconstructed image data horizontally compressed to 1/2, based on the time-axis prediction error data provided by the inverse orthogonal transformation circuit and on predetermined reference image data; and

one or more than one reference image memories for storing reconstructed image data which is included in the reconstructed image data provided by the inverse orthogonal transformation circuit or the adder and is needed for generating the reference image data.

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2. A motion picture decoding apparatus as set forth in Claim 1 wherein said certain sized block is based on an MXN block unit including an M number of horizontal pixels and an N number of vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (b) provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (a):

$$F(u,v)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot C(u)C(v)\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}f(i,j)\times\cos\left\{\frac{(2i+1)u\pi}{2M}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\} \qquad \cdots(a)$$

wherein

$$i,u=0,1,2,\cdots(M-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

$$f(i,j)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot\sum_{u=0}^{\frac{M}{2}-1}\sum_{v=0}^{N-1}C(u)C(v)F(u,v)\times\cos\left\{\frac{(2i+1)u\pi}{2\cdot M/2}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\} \qquad \cdots(b)$$

wherein

$$i,u=0,1,2,\cdots(M/2-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

3. A motion picture decoding apparatus as set forth in Claim 1 wherein said certain sized block is based on an 8x8 block unit including 8 horizontal pixels and 8 vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (d)

provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (c):

$$F(u,v) = \frac{1}{4} \cdot C(u)C(v) \sum_{i=0}^{7} \sum_{j=0}^{7} f(i,j) \times \cos\left\{\frac{(2i+1)u\pi}{16}\right\} \cos\left\{\frac{(2j+1)v\pi}{16}\right\} \quad \cdots (c)$$

wherein

$i, u = 0, 1, 2, \cdots 7$

$j, v = 0, 1, 2, \cdots 7$

$$C(u), C(v) = \begin{cases} 1/\sqrt{2} & (u = 0 \; or \; v = 0) \\ 1 & (u \neq 0, v \neq 0) \end{cases}$$

$$f(i,j) = \frac{1}{4} \cdot \sum_{u=0}^{3} \sum_{v=0}^{7} C(u)C(v)F(u,v) \times \cos\left\{\frac{(2i+1)u\pi}{8}\right\} \cos\left\{\frac{(2j+1)v\pi}{16}\right\} \quad \cdots (d)$$

wherein

$i, u = 0, 1, 2, 3$

$j, v = 0, 1, 2, \cdots 7$

$$C(u), C(v) = \begin{cases} 1/\sqrt{2} & (u = 0 \; or \; v = 0) \\ 1 & (u \neq 0, v \neq 0) \end{cases}$$

4. A motion picture decoding apparatus as set forth in Claim 1 further comprising a motion compensation circuit for performing a motion compensation operation on image data of a certain size with a horizontal accuracy of 1/4 pel and a vertical accuracy of 1/2 pel, the image data read from the reference image memory for generation of the reference image data and horizontally compressed to 1/2 relative to an original picture.

5. A motion picture decoding apparatus comprising:

a coefficient reducing circuit for removing orthogonal transform coefficients for high horizontal frequencies from a certain sized block of orthogonal

transform coefficients obtained from an input signal, thereby reducing the number of transform coefficients to half;

an inverse orthogonal transformation circuit for performing an inverse orthogonal transform operation by using the transform coefficients reduced by the coefficient reducing circuit, thereby obtaining, on a block-by-block basis, reconstructed image data or time-axis prediction error data horizontally compressed to 1/2;

an adder for generating reconstructed image data horizontally compressed to 1/2, based on the time-axis prediction error data provided by the inverse orthogonal transformation circuit and on predetermined reference image data;

a vertical deletion circuit for deleting a half of the horizontal lines of the reconstructed image data supplied from the inverse orthogonal transformation circuit or the adder, thereby generating reconstructed image data compressed to 1/2 with respect to the horizontal and vertical directions, respectively; and

one or more than one reference image memories for storing reconstructed image data which is included in the reconstructed image data provided by the vertical deletion circuit and is needed for generating the

reference image data,

the motion picture decoding apparatus wherein the reconstructed image data stored in the reference image memory is used for generating the reference image data compressed to 1/2 only with respect to the horizontal direction.

6. A motion picture decoding apparatus as set forth in Claim 5 wherein said certain sized block is based on an MXN block unit including an M number of horizontal pixels and an N number of vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (f) provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (e):

$$F(u,v)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot C(u)C(v)\sum_{i=0}^{M-1}\sum_{j=0}^{N-1} f(i,j)\times\cos\left\{\frac{(2i+1)u\pi}{2M}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\} \qquad \cdots(e)$$

wherein

$$i,u=0,1,2,\cdots(M-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

$$f(i,j)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot\sum_{u=0}^{\frac{M}{2}-1}\sum_{v=0}^{N-1} C(u)C(v)F(u,v)\times\cos\left\{\frac{(2i+1)u\pi}{2\cdot M/2}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\} \qquad \cdots(f)$$

wherein

$$i,u=0,1,2,\cdots(M/2-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

7. A motion picture decoding apparatus as set forth in Claim 5 wherein said certain sized block is based on an 8x8 block unit including 8 horizontal pixels and 8 vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (h) provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (g):

$$F(u,v)=\frac{1}{4}\cdot C(u)C(v)\sum_{i=0}^{7}\sum_{j=0}^{7}f(i,j)\times\cos\left\{\frac{(2i+1)u\pi}{16}\right\}\cos\left\{\frac{(2j+1)v\pi}{16}\right\} \quad \cdots(g)$$

wherein

$i,u=0,1,2,\cdots 7$

$j,v=0,1,2,\cdots 7$

$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

$$f(i,j)=\frac{1}{4}\cdot\sum_{u=0}^{3}\sum_{v=0}^{7}C(u)C(v)F(u,v)\times\cos\left\{\frac{(2i+1)u\pi}{8}\right\}\cos\left\{\frac{(2j+1)v\pi}{16}\right\} \quad \cdots(h)$$

wherein

$i,u=0,1,2,3$

$j,v=0,1,2,\cdots 7$

$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

8. A motion picture decoding apparatus as set forth in Claim 5 wherein said vertical deletion circuit performs a vertical deletion processing by vertically deleting, at regular intervals, two successive horizontal lines in every four successive horizontal lines of the reconstructed image data provided by the inverse

orthogonal transformation circuit or the adder.

9. A motion picture decoding apparatus comprising:

a coefficient reducing circuit for removing orthogonal transform coefficients for high horizontal frequencies from a certain sized block of orthogonal transform coefficients obtained from an input signal, thereby reducing the number of transform coefficients to half;

an inverse orthogonal transformation circuit for performing an inverse orthogonal transform operation by using the transform coefficients reduced by the coefficient reducing circuit, thereby obtaining, on a block-by-block basis, first reconstructed image data or time-axis prediction error data horizontally compressed to 1/2;

an adder for generating first reconstructed image data horizontally compressed to 1/2, based on the time-axis prediction error data provided by the inverse orthogonal transformation circuit and on predetermined reference image data;

an Hadamard transformation coding circuit for quantizing, based on Hadamard transformation, the first reconstructed image data provided by the inverse orthogonal transformation circuit or the adder, thereby generating second reconstructed image data, the amount

of which data is reduced bitwise to 1/2 from that of the first reconstructed image data; and

one or more than one reference image memories for storing second reconstructed image data which is included in the second reconstructed image data provided by the Hadamard transformation coding circuit and is needed for generating the reference image data,

the motion picture decoding apparatus wherein the second reconstructed image data stored in the reference image memory is used for generating the reference image data corresponding to the first reconstructed image data.

10. A motion picture decoding apparatus as set forth in Claim 9 wherein said certain sized block is based on an MXN block unit including an M number of horizontal pixels and an N number of vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (j) provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (i):

$$F(u,v)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot C(u)C(v)\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}f(i,j)\times\cos\left\{\frac{(2i+1)u\pi}{2M}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\} \qquad \cdots(i)$$

wherein

$$i,u=0,1,2,\cdots(M-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

$$f(i,j)=\frac{2}{\sqrt{M}\sqrt{N}}\cdot\sum_{u=0}^{\frac{M}{2}-1}\sum_{v=0}^{N-1}C(u)C(v)F(u,v)\times\cos\left\{\frac{(2i+1)u\pi}{2\cdot M/2}\right\}\cos\left\{\frac{(2j+1)v\pi}{2N}\right\}\qquad\cdots(j)$$

wherein

$$i,u=0,1,2,\cdots(M/2-1)$$
$$j,v=0,1,2,\cdots(N-1)$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

11. A motion picture decoding apparatus as set forth in Claim 9 wherein said certain sized block is based on an 8x8 block unit including 8 horizontal pixels and 8 vertical pixels, and wherein the inverse orthogonal transformation circuit performs the inverse orthogonal transform operation based on the following equation (l) provided that an original picture has been encoded by an orthogonal transform operation based on the following equation (k):

$$F(u,v)=\frac{1}{4}\cdot C(u)C(v)\sum_{i=0}^{7}\sum_{j=0}^{7}f(i,j)\times\cos\left\{\frac{(2i+1)u\pi}{16}\right\}\cos\left\{\frac{(2j+1)v\pi}{16}\right\}\qquad\cdots(k)$$

wherein

$$i,u=0,1,2,\cdots 7$$
$$j,v=0,1,2,\cdots 7$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

$$f(i,j)=\frac{1}{4}\cdot\sum_{u=0}^{3}\sum_{v=0}^{7}C(u)C(v)F(u,v)\times\cos\left\{\frac{(2i+1)u\pi}{8}\right\}\cos\left\{\frac{(2j+1)v\pi}{16}\right\}\qquad\cdots(l)$$

wherein

$$i,u=0,1,2,3$$
$$j,v=0,1,2,\cdots 7$$
$$C(u),C(v)=\begin{cases}1/\sqrt{2} & (u=0\ or\ v=0)\\ 1 & (u\neq 0, v\neq 0)\end{cases}$$

12. A motion picture decoding apparatus as set forth

in Claim 9 further comprising a motion compensation circuit for performing a motion compensation operation on image data of a certain size with a horizontal accuracy of 1/4 pel and a vertical accuracy of 1/2 pel, the image data read from the reference image memory for generation of the reference image data and horizontally compressed to 1/2 relative to an original picture.

13. A motion picture decoding apparatus comprising:

an inverse orthogonal transformation circuit for performing an inverse orthogonal transform operation on a certain sized block of orthogonal transform coefficients obtained from an input signal, thereby providing first reconstructed image data or time-axis prediction error data;

an adder for generating first reconstructed image data based on the time-axis prediction error data provided by the inverse orthogonal transformation circuit and predetermined reference image data;

an Hadamard transformation coding circuit for quantizing, based on Hadamard transformation, the first reconstructed image data provided by the inverse orthogonal transformation circuit or the adder, thereby generating second reconstructed image data, the amount of which data is reduced bitwise from that of the first reconstructed image data; and

one or more than one reference image memories for storing second reconstructed image data which is included in the second reconstructed image data provided by the Hadamard transformation coding circuit and is needed for generating the reference image data,

the motion picture decoding apparatus wherein the second reconstructed image data stored in the reference image memory is used for generating the reference image data corresponding to the first reconstructed image data.

14. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been removed, or on a combination of said obtained image data and reference image data;

a second step of committing reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the reconstructed image data provided by the first step and is needed for generating the reference image data; and

a third step of generating the reference image data based on the reconstructed image data stored in the reference image memory.

15. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been removed, or on a combination of said obtained image data and reference image data;

a second step of generating second reconstructed image data by subjecting the first reconstructed image data to at least one of a horizontal deletion processing and a vertical deletion processing;

a third step of committing second reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the second reconstructed image data provided by the second step and is needed for generating the reference image data; and

a fourth step of generating the reference image data corresponding to the first reconstructed image data by using the second reconstructed image data stored in the reference image memory.

16. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed

image data based on image data obtained through an inverse DCT operation or on a combination of said obtained image data and reference image data;

a second step of performing an Hadamard transformation-based coding operation on the first reconstructed image data thereby generating second reconstructed image data, the amount of which data is reduced bitwise from that of the first reconstructed image data;

a third step of committing second reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the second reconstructed image data provided by the second step and is needed for generating the reference image data; and

a fourth step of generating the reference image data corresponding to the first reconstructed image data by using the second reconstructed image data stored in the reference image memory.

17. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been removed, or on a combination of said

obtained image data and reference image data;

a second step of performing an Hadamard transformation-based coding operation on the first reconstructed image data thereby generating second reconstructed image data, the amount of which data is reduced bitwise from that of the first reconstructed image data;

a third step of committing second reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the second reconstructed image data provided by the second step and is needed for generating the reference image data; and

a fourth step of generating the reference image data corresponding to the first reconstructed image data by using the second reconstructed image data stored in the reference image memory.

18. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been replaced with "0", or on a combination of said obtained image data and reference image data;

a second step of performing an Hadamard transformation-based coding operation on the first reconstructed image data thereby generating second reconstructed image data, the amount of which data is reduced bitwise from that of the first reconstructed image data;

a third step of committing second reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the second reconstructed image data provided by the second step and is needed for generating the reference image data; and

a fourth step of generating the reference image data corresponding to the first reconstructed image data by using the second reconstructed image data stored in the reference image memory.

19. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation or on a combination of said obtained image data and reference image data;

a second step of generating second reconstructed image data by subjecting the first reconstructed image data to at least one of a horizontal deletion processing

and a vertical deletion processing;

a third step of performing an Hadamard transformation-based coding operation on the second reconstructed image data thereby generating third reconstructed image data, the amount of which data is reduced bitwise from that of the second reconstructed image data;

a fourth step of committing third reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the third reconstructed image data provided by the third step and is needed for generating the reference image data; and

a fifth step of generating the reference image data corresponding to the first reconstructed image data by using the third reconstructed image data stored in the reference image memory.

20. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been removed, or on a combination of said obtained image data and reference image data;

a second step of generating second reconstructed

image data by subjecting the first reconstructed image data to at least one of a horizontal deletion processing and a vertical deletion processing;

a third step of performing an Hadamard transformation-based coding operation on the second reconstructed image data thereby generating third reconstructed image data, the amount of which data is reduced bitwise from that of the second reconstructed image data;

a fourth step of committing third reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the third reconstructed image data provided by the third step and is needed for generating the reference image data; and

a fifth step of generating the reference image data corresponding to the first reconstructed image data by using the third reconstructed image data stored in the reference image memory.

21. A motion picture decoding process for decoding a signal compression coded based on the MPEG Standards, the process comprising the steps of:

a first step of generating first reconstructed image data based on image data obtained through an inverse DCT operation using DCT coefficients, a part of which coefficients has been replaced with "0", or on a

combination of said obtained image data and reference image data;

a second step of generating second reconstructed image data by subjecting the first reconstructed image data to at least one of a horizontal deletion processing and a vertical deletion processing;

a third step of performing an Hadamard transformation-based coding operation on the second reconstructed image data thereby generating third reconstructed image data, the amount of which data is reduced bitwise from that of the second reconstructed image data;

a fourth step of committing third reconstructed image data to storage at a reference image memory, which reconstructed image data is included in the third reconstructed image data provided by the third step and is needed for generating the reference image data; and

a fifth step of generating the reference image data corresponding to the first reconstructed image data by using the third reconstructed image data stored in the reference image memory.